The reproduction and pathology of *Pratylenchus penetrans* on some varieties of lettuce

Federico Moretti, Alba Cotroneo and Gennaro Mancini

Regione Piemonte, Osservatorio per le Malattie delle Piante, Via San Secondo, 39, 10128 Torino, Italy.

Summary

The reproduction and pathology of *Pratylenchus penetrans* has been observed on five cultivars of lettuce (*Lactuca sativa* var. *scarola*) : Parella, Lattughino biondo Lollo, S. Anna, Regina dei Ghiacci and Aurelia at different soil temperatures and light exposure periods in climate-controlled units. The maximum population increase occurred at 21-22° and at 14 hour/day in Parella and S. Anna varieties. Reproduction was reduced but not inhibited at 14-15° and 12 hour/day, except in the Aurelia variety where reproduction ceased.

None of the varieties tested were found to be resistant.

Résumé

Reproduction et pathogénie de Pratylenchus penetrans *sur quelques variétés de laitue*

Les auteurs ont observé la reproduction et la pathogénie d'une population génétiquement hétérogène de *Pratylenchus penetrans* en relation avec cinq variétés de laitue (Lattughino Parella, Lattughino biondo Lollo, S. Anna, Regina Dei Ghiacci et Aurelia) et suivant trois combinaisons de température et de lumière, en enceinte climatisée. Le développement de la population a été le meilleur à 20° et 14 h de lumière sur les variétés Parella et S. Anna, mais seule la première a été sérieusement lésée par le parasite. A 15° et 12 h de lumière, et à 30° et 16 h de lumière, la reproduction du nématode est stoppée sur la variété Aurelia et ralentie sur les autres.

Aucune des variétés ne s'est montrée totalement résistante. Les observations concernant l'histopathologie ne diffèrent pas de celles concernant les autres plantes envahies par les nématodes du même genre.

Samples of soil and plants from horticultural crops in various zones throughout Piedmont (Northern Italy) almost without exception contained populations of *Pratylenchus penetrans* in varying densities. Despite the widespread distribution it proved difficult to correlate the population density with the crop reduction in the field.

It is well known that the variability of disease symptoms in plants depends on a wide range of ecological and stress factors, from the genetic pool of the host and parasite to the techniques of cultivation.

In a previous study of *P. penetrans* on lettuce (Mancini & Moretti, 1974) host-parasite response differed according to the variety of the host and the environmental conditions, but it was extremely difficult to quantify the factors responsible.

The aim of the present study was to verify at the experimental level the impressions gained from field-observations, and to study the differing susceptibilities of some varieties of lettuce (*Lactuca sativa* var. *scarola*) in different environmental conditions, to the attack of a genetically heterogeneous population of *P. penetrans*.

Materials and methods

The inoculum of the parasite was taken from a population of *P. penetrans* reared and built-up in greenhouse on benches containing a sandy-loam soil. Many host plants, including lettuce, were cultivated on these benches and *P. penetrans* collected from different sources were added to the original population, in an attempt to keep this population as genetically varied as possible.

The host plants were grown from commercial seeds of five cultivars of *Lactuca sativa* var. *scarola:* Lattughino Parella, Lattughino biondo Lollo, S. Anna, Regina dei ghiacci and Aurelia.

The soil containing nematodes was mixed with steam sterilized and air-dried soil in suitable proportions to obtain a population density of about 250 larvae and adults per 100 ml of soil (about 2 250/kg), very similar to that observed in the field.

The control soil used was not sterile but was nematode-free having been previoulsy treated with D-D, and was mixed with sterilized soil in the same proportions as was the soil containing nematodes so as to ensure the presence of the same organisms in all soils. A 5-12-10 fertilizer, at the rate of 300 g/m³, was applied before the sowing to all the soil.

The experimental units consisted of plastic pots of 80 mm diameter containing 200 ml of soil, in which ten seeds dressed with Captan at the rate of 2 g/kg were planted.

The seedlings were thinned out by cutting the plumule to obtain an average density of five seedlings per pot. The experiment was carried out in controlled climate units in three different sets of conditions of temparature and fluorescent light : 15 $\pm$ 2° with 12 hours of light ; 20 $\pm$ 2° with 14 hour of light and 30 $\pm$ 2° with 16 hour of light. In all cases the relative humidity of the environment was kept at levels of 75-80%, and the pots were watered with tap-water at about the same temperature as the soil.

Every week, during 42 days, sixteen pots for each variety of lettuce were choosed at random and grouped four by four to obtain four replications. The nematode population level was valued on soil subsamples of 200 ml extracted from the mixture of the entire soil of each replication and from roots of five plants per replication.

The nematodes were extracted from the soil by the centrifugal-flotation technique (Jenkins, 1964), and from the roots by a Baermann funnel. At the same time the increase in weight of the seedlings was noted.

At the end of the experiment the infested seedlings' roots were fixed in F.A.A., embedded in paraffin and cut in sections of 10µm stained with safranin and fast green (Johansen, 1940).

Results

In soil with a temperature of about 20° *P. penetrans* reproduced actively on the Parella and S. Anna cultivars of lettuce reaching population densities (i.e. total number of nematodes in soil and roots) of 210% and 205% respectively of the initial inoculum after 42 days. The final population level on the cv. Lollo was also significantly higher than the initial level (159%). Although the final level observed on the cv. Regina dei Ghiacci was 145% of the initial population it was found not to be a statistically significant increase. Initially, on the cv. Aurelia, a slight decrease of the population was seen, but towards the end of the experiment the population increased again, reaching approximately the original density (Fig. 2).

There was a statistically significant increase of the mean number of nematodes per gram of root only in the cultivars Parella and Regina dei Ghiacci. Nematode feeding caused a 31% weight loss in the edible part of the plant only in the cv. Parella. Plant development and maturity were retarded in the inoculated soil. In the other four cultivars the differences in weight at the end of the experiment was about $\pm$ 5% compared to the control and during growth no differences were seen in development.

At soil-temperature of about 15° the reproduction of the parasite was reduced : after an initial fall more marked in cultivars Aurelia, Regina dei ghiacci and Lollo (30%) than in Parella and S. Anna (10%), the population level remained more or less at the value reached with only small variations (Fig. 1). The cessation in the reproduction was confirmed by the continuous decrease in the number of nematodes per gram of root. When the soil-temperature was raised to about 20° a notable renewal of the reproduction was observed. Only in the cv. Aurelia did the population decrease continuously.

The development of the inoculated seedlings, in all the varieties tested, showed no diffrence with respect to the control.

At 30° the reduction in reproduction was repeated with a more marked initial decrease of the population (Fig. 3). The only notable difference was that the majority of the nematodes were in the roots at 30°, whereas in the

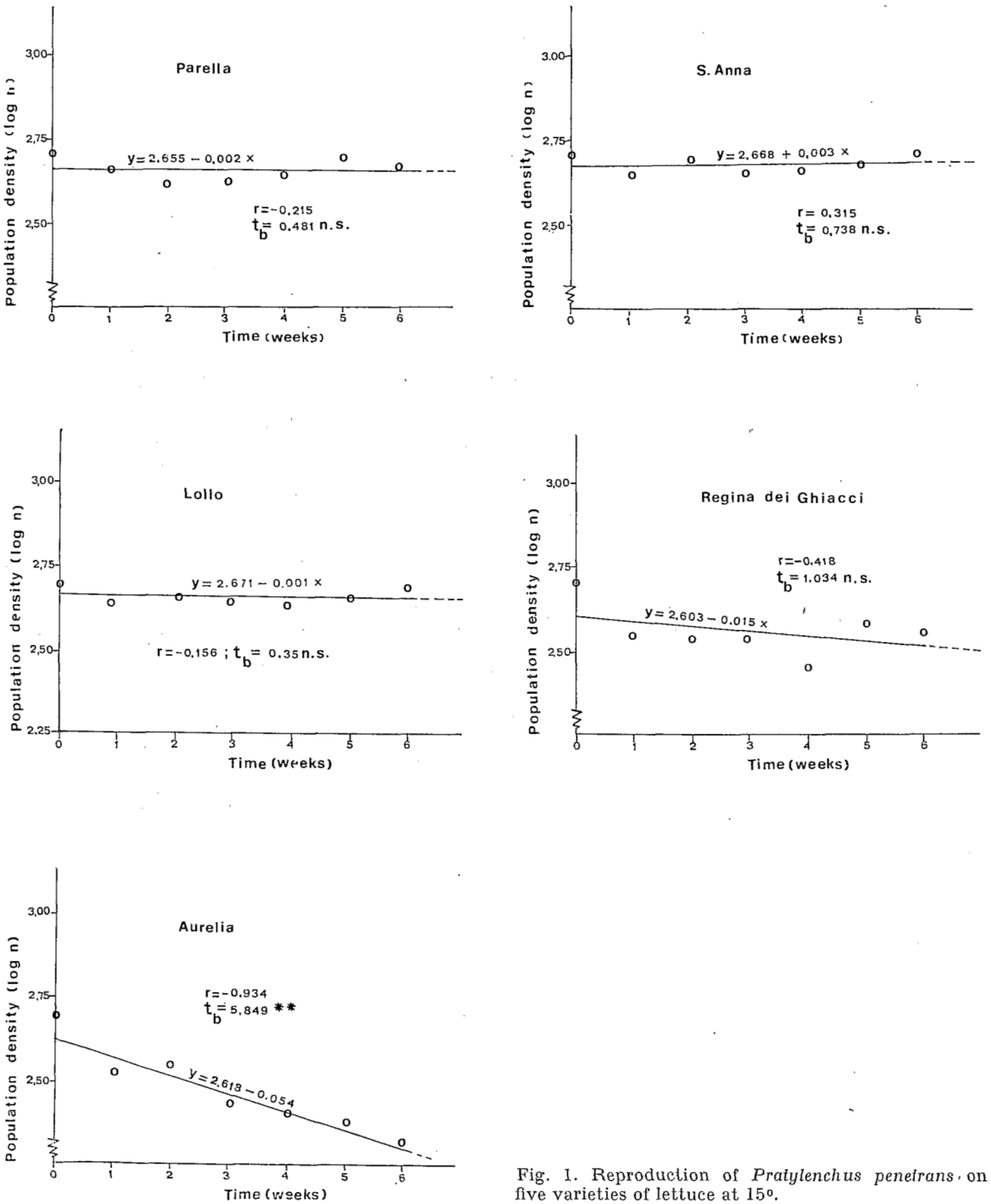


Fig. 1. Reproduction of *Pratylenchus penetrans* on five varieties of lettuce at 15°.

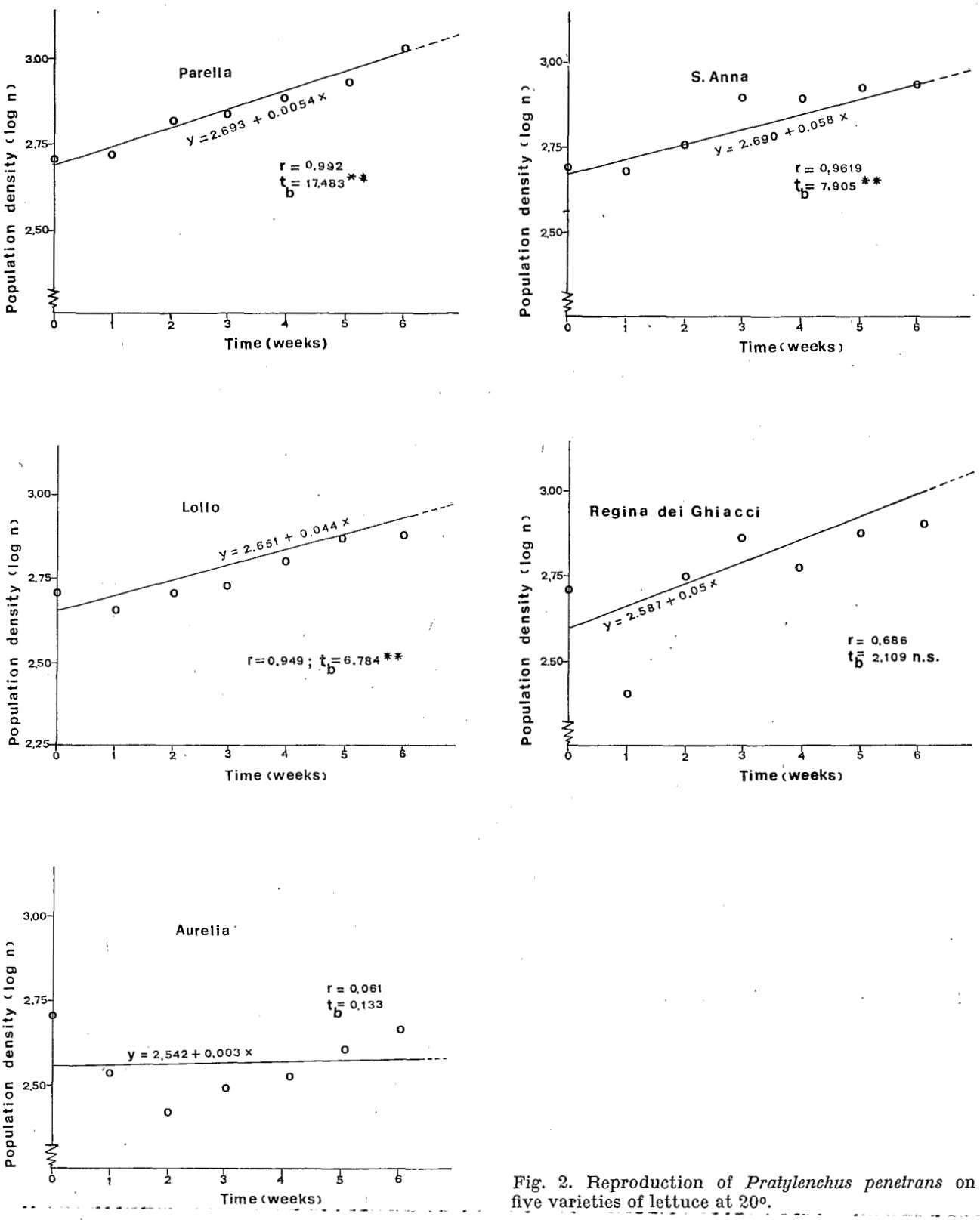
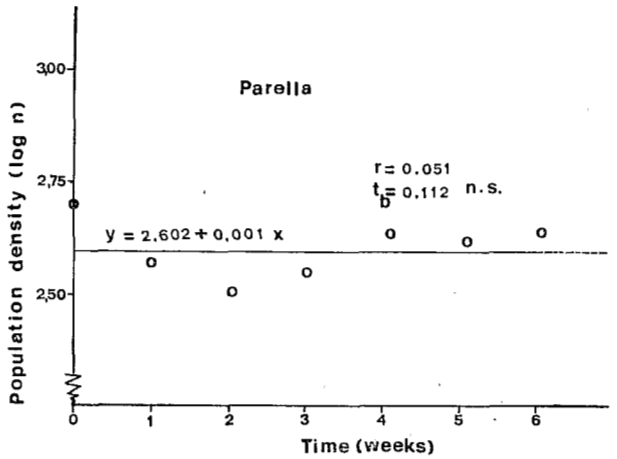
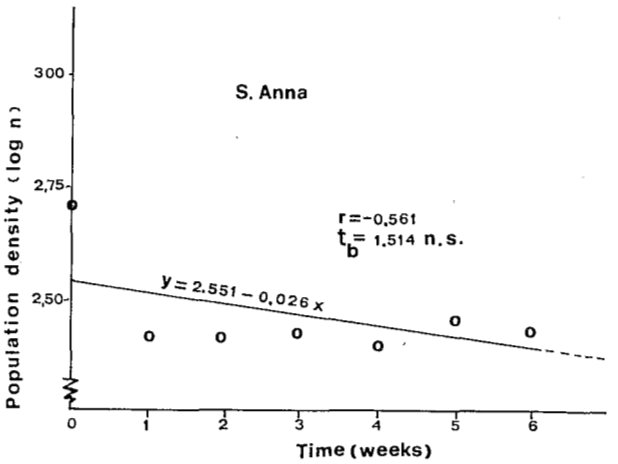
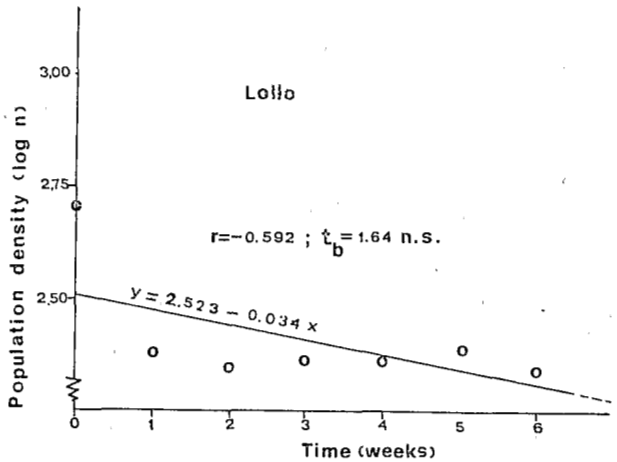
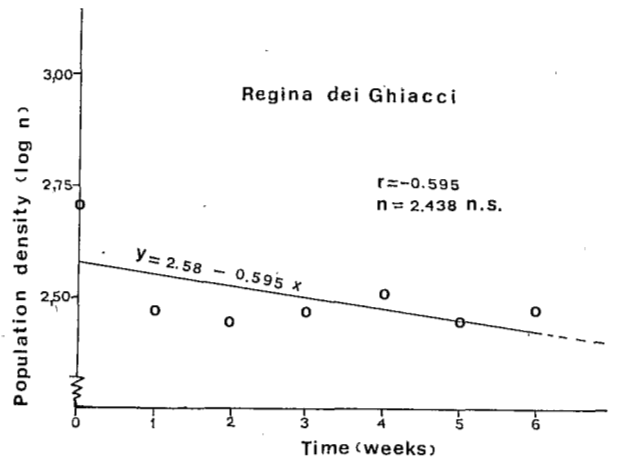


Fig. 2. Reproduction of *Pratylenchus penetrans* on five varieties of lettuce at 20°.









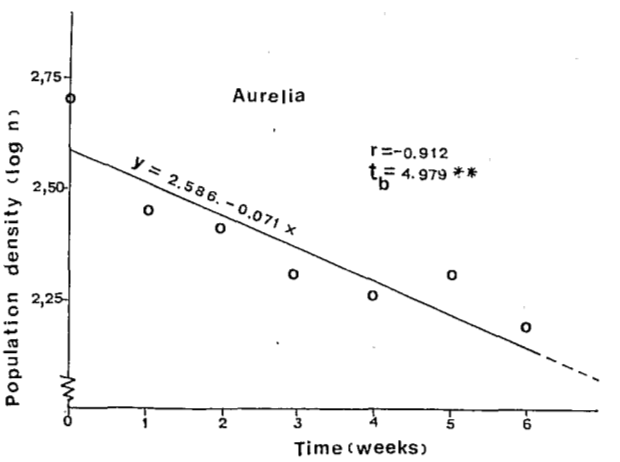


Fig. 3. Reproduction of *Pratylenchus penetrans* on five varieties of lettuce at 30°.

other experimental conditions the majority of nematodes were present in the soil, as observed also on lucerne (Kinpinski & Willis, 1978).

Conclusions

These results suggest that soil temperature is a major factor for determinating the outcome of an infestation of *P. penetrans* on lettuce. At 20° the reproduction of the parasite is particularly active, the development is completed in about twenty days and the life-cycle takes place in about 40 days ; this value is close to those observed on potato and onion (Wong & Ferris, 1968), *Cryptomeria japonica* (Mamiya, 1971), lucerne (Dunn, 1973). At the initial population density of 250 individuals per 100 ml of soil, *P. penetrans* only reduced plant growth and development in the cv. Lattughino Parella. The cultivars Lollo and S. Anna were tolerant of this threshold, showing no damage even after the successive population increase. For cultivars comparable to these a threshold of 6 000 *P. penetrans*/kg of soil has been found (Olthof & Potter, 1973 ; Potter & Olthof, 1974). The cultivars Regina dei Ghiacci and Aurelia were found to be unsuitable hosts for the nematode, without appearing to have any particular specific host resistance-reaction.

Soil temperature of 15° and 30° suppressed nematode reproduction and growth and crop damage, which explains at least in part, our earlier observation that infestations in late spring were more severe than those found in early spring or full summer. The host susceptibility to the root-lesion nematode did not seem to be affected by the lowest temperature unlike it has been observed in onion seedlings (Ferris, 1970).

Histopathological findings for the roots of all cultivars of lettuce infested with *P. penetrans* were essentially similar to those for other hosts infested with this nematode.

Accepté pour publication le 7 mai 1981.

References

Dunn, R.A. (1973). Effect of temperature on survival and reproduction of *Pratylenchus penetrans* (Cobb, 1917) Filipjev & Schuurmans Stekhoven, 1941. *Dissert. Abstr.*, 34 B : 14.

Ferris, J.M. (1970). Soil temperature effects on onion seedlings injury by *Pratylenchus penetrans*. *J. Nematol.*, 2 : 248-251.

Jenkins, W.R. (1964). A rapid centrifugal-flotation technique for separating nematodes from soil. *Pl. Dis. Reptr*, 48 : 692.

Kimpinski, J. & Willis, C.B. (1978). Effect of soil temperature and pH on *Pratylenchus penetrans* and *P. crenatus*. Abstract. *J. Nematol.*, 10 : 293.

Johansen, D.A. (1940). *Plant microtechnique*. New York & London, McGraw-Hill Book Company Inc., XI + 523 p.

Mamiya, Y. (1971). Effect of temperature on the life-cycle of *Pratylenchus penetrans* on *Cryptomeria* seedlings and observations on its reproduction. *Nematologica*, 17 : 82-92.

Mancini, G. & Moretti, F. (1974). Infestazione di *Pratylenchus penetrans* su *Lactuca sativa* e *Galinsoga parviflora*. *Inftore Fitopatol.*, 24 : 23-26.

Olthof, T.H.A. & Potter, J.W. (1973). The relationship between population densities of *Pratylenchus penetrans* and crop losses in summer-maturing vegetables in Ontario. *Phytopathology*, 63 : 577-582.

Potter, J.W. & Olthof, T.H.A. (1974). Yield losses in fall-maturing vegetables relative to population densities of *Pratylenchus penetrans* and *Meloidogyne hapla*. *Phytopathology*, 64 : 1072-1075.

Wong, K. & Ferris, J.M. (1968). Factors influencing the population fluctuation of *Pratylenchus penetrans* in soil. III. Host plant species. *Phytopathology*, 58 : 662-665.